Model 1000 Powered Interface Tester

User's Manual

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INTRODUCTION

The Ultimate in Interface Testing. The Model 1000 is the most advanced instrument of its kind in the marketplace today. Packed with features, it's designed to make your life easier by providing you a degree of functionality, quality, and portability that you just can't get elsewhere. Take a look at the list of features and see if you don't agree.

Full definition at a glance. By utilizing red and green LEDs on all 25 lines on the DCE side and all 25 lines on the DTE side (100 LEDs total), the Model 1000 provides you the signal status of all the lines at a glance (four states: mark, space, clocking, and off).

Self powered for high impedance and accuracy. Because the Model 1000 provides its own power (two 9 volt batteries included), we designed in 100 high input impedance amplifiers to drive the LEDs. This approach has two direct benefits. First, the high impedance circuitry allows you to monitor the signal lines without affecting the signal levels. And secondly, you now have the extra sensitivity necessary to detect troublesome crosstalk and noise along with the normal plus and minus logic levels.

Useful for testing a variety of interfaces. This extra sensitivity also allows us to recommend the Model 1000 for testing low power interface circuitry (e.g. parallel interfaces) in addition to RS-232C serial applications. For parallel data detection and observation, the LED ground line (normally pin 7 for RS-232C) may be strapped to any of the 25 lines

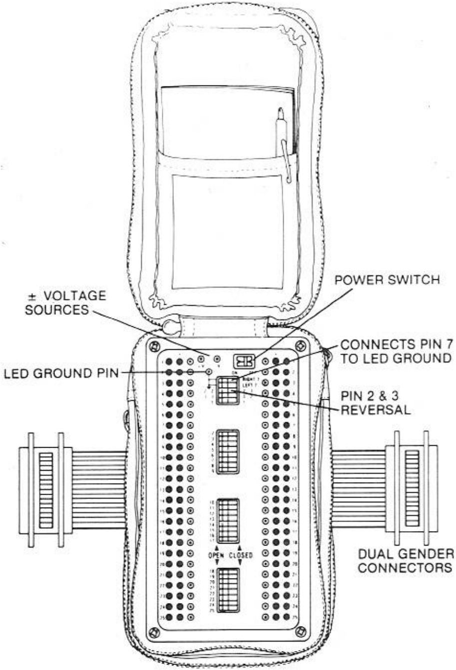
designated as logic ground.

Quick reconfiguration. Complete cable "breakout" and reconfiguration capability exists with 25 in-line switches, and 0.25" square strapping posts with attendant jumper wires. We've even made some often used reconfigurations easier by providing 2/3 swap and loopback testing at the flip of some switches instead of having you reach for jumper wires.

Control signal simulation. Both ± 9 volt DC sources are provided on the faceplate for strapping control lines to the desired logic levels - very handy when you want to simulate various control signal states.

Analyze cables. These voltage sources also allow the Model 1000 to act as a comprehensive cable tester. To determine how a cable is "wired", simply hook it up to the Model 1000 and apply voltage to the lead in question. The LEDs show the connections. With the optional Remote Indicator, you can do the same for cables that are already installed.

Extra measure of protection. The Model 1000 is built into our unique three zipper "Softpack" case. The batteries are conveniently accessible through a zippered top compartment. Attached extender cables with dual gender connectors conveniently fold under the electronics unit into their own zippered compartment. When not in use, a padded vinyl cover containing the jumper straps and instruction manual is zippered shut to provide total protection and security for this quality instrument.


POWER SWITCH
± VOLTAGE SOURCES
CONNECTS PIN 7 TO LED GROUND
LED GROUND PIN
PIN 2 & 3 REVERSAL
OPEN
CLOSED
DUAL GENDER CONNECTORS

GETTING TO KNOW THE MODEL 1000

Connection. The Model 1000 Interface Tester provides two cables, each with male and female 25 pin connectors, for in-line connection with the data communications interface. All 25 lines are routed through the tester. Each line is monitored on both sides of the breakout switches with high input impedance amplifiers which drive the red and green LEDs.

Power Considerations. A power ON-OFF switch is located in the upper right hand corner of the faceplate. Moving this switch to the ON position applies both plus and minus battery voltage to the amplifiers. If this switch is inadvertently left in the ON position when the tester is not being used, only a few nanoamps of leakage current will be drawn from the batteries. Thus, providing there are no interface connections to the unit, the battery life will approach the rated "shelf life" of the batteries even if you forget and leave the unit ON. If it is desired to leave the tester in an active interface circuit for an extended period of time, it is advisable to turn the power switch OFF to conserve battery life. The interface tester is completely isolated and transparent to the data circuits with the power switch either ON or OFF. However, when the LED lamps are on, each lamp consumes approximately 5 milliamps of current from the batteries. The two Duracell batteries which are supplied with the unit are rated at 500 milliamp hours. Access to the batteries is through the zippered compartment at the top of the case.

The Top Four Switches. Locate the five position "dip" switch at the top-center of the tester's faceplate. The top two switch positions connect the battery and LED ground lines to Pin 7 on the right and left side of the breakout switches, respectively. Because of the RS-232C specification defines pin 7 as "signal ground", these two switches are normally in the closed position (right side down) when testing RS-232 interface circuits. To isolate the tester's logic ground circuitry so that it may be strapped to any other pin (such as in testing parallel interface circuitry) both switches should be pushed down to the left. A jumper strap may then be connected between the ground post and any other pin identified as logic ground.

The third and fourth switch positions from the top are provided to quickly reverse pins 2 & 3 in an RS-232 test application. This configuration is commonly referred to as "null modem". To accomplish this reversal, open (push down to the left) the switches labeled "2" and "3" located on the second switch deck. Then close (down to the right) the switches labeled "2-3" and "3-2" on the top switch deck. For "loopback testing", switches "2" and "3" should be closed along with either switch "2-3" or "3-2".

The Remaining 25 Switches. The fifth switch on the top deck labeled "1", and the remaining 24 switches labeled "2" through "25" will break open the data and control lines when pushed down to the left. When starting to test an interface, all line switches should be closed and the "2-3" and "3-2" reversal switches on the top deck should be open.

Signal Polarity. The LED indicators in the Model 1000 will indicate the polarity of the logic level present on the data or control lines. The red LEDs will light when a positive voltage is present and in the range of the RS-232C specification. A positive voltage is known as a "binary zero", "signal space", or "control on" condition. The green LEDs will light at the opposite negative voltage level. A negative voltage is known as a "binary one", "signal mark", or "control off" condition. When the signal is alternating between binary zero and binary one ("clocking"), both the red and green LEDs will light. At high data rates, both red and green LEDs will appear to be in a steady lighted condition.

Voltage on the Faceplate. Both + and − voltages are provided on .025" square strapping posts at the top-left of the faceplate. These voltages can be used to "strap" an interface control line to a logic "high" or "low" condition. In addition, these voltages may be used to test cables for continuity, opens and bridging. A logic common or ground pin is also provided for strapping an interface control line to ground.

NOTE: There are no current limiting resistors in either the + or − voltage outputs, or within the signal ground line. Care should be taken so that the supply voltages are not shorted to ground or logic ground lines (pin 1 & 7 in RS-232C) for any length of time. No damage will occur in the interface tester, but the battery life will be substantially shortened.

Reconfiguring the Signal Paths with Jumpers. Changing an interface configuration may be easily accomplished by using the breakout switches and the jumper straps. Five single wire jumpers and one, four-way bridging jumper are supplied with the unit, and are contained in the pocket of the zip-on lid.

OPERATION
RS-232C SERIAL APPLICATIONS

Background - The RS232 Standard. The RS-232C communication standard was conceived to allow Data Terminal Equipment (DTE) such as computers, terminals and printers to communicate over long distance via Data Communications Equipment (DCE) such as modems and telephone networks. As such, the DCE modems (short for modulator - demodulator) performed such necessary functions as taking the "Transmit Data" from the terminal equipment at one location and converting it to "Receive Data" at the second location, as well as controlling the necessary timing and hand shake functions between the two terminal devices. When data terminal equipment (DTE) are located in close proximity (typically within 50 feet) the data communications equipment (DCE) is not normally required. Therefore to communicate properly, the interface between the terminal equipment must be made to emulate the data conversion and control functions normally performed by the DCE modems. This necessary emulation is typically performed in

the external connecting cable between the two terminal devices.

Without a knowledge of the discrete RS-232 signal requirements, the construction of the cable may become a frustrating trial and error task. The Model 1000 Interface Tester provides a convenient instrument to examine the logic state of each line, and to quickly reconfigure the cable to match the two devices being interfaced.

Before you start please refer to Appendix A for some prerequisites to interface testing, Appendix B for a complete definition of the RS-232C signal paths, and Appendix C for an example of how to solve interface problems with the Model 1000.

How to use the Model 1000 to Test RS-232C Serial Interfaces. Connect the interface tester in-line with the RS-232 cable connecting the two equipments to be interfaced. It is not important as to which side of the tester is connected to which device.

Initially, make sure that all switches are closed, with the exception of the 2-3 reversal switches located on the top switch deck, and they should be "OPEN".

Power up the two devices being interfaced. The tester will indicate the steady-state logic levels that are present on the interface cable.

Familiarity with the primary data and control line functions of the RS-232C standard is necessary before complex interface networks can be properly analyzed. In addition, it is

highly desirable that the installation and operation manuals for the equipment being interfaced, be available to identify the specific requirements for each device.

The following discussion relates to the typical utilization of a breakout box in testing RS-232C interfaces.

Typically, pins 2 and 3 are the Transmit and Receive data lines respectively. In the resting state, these lines are normally at the logic "1" level, indicated by the green LED's being lit on pins 2 and 3. If no LED's are lit on pins 2 and 3, this indicates there are either no connections, or there are possibly two transmitters and two receivers connected end to end in an opposing manner. To determine if there are two transmitters connected in an opposing fashion, OPEN switch positions 2 and 3. If any of the LED's on pins 2 and 3 light, this indicates that pins 2 and 3 should be crossed. To accomplish this, CLOSE the 2-3 and 3-2 reversal switches on the top switch deck. This will route pin 2 on the left to pin 3 on the right, and pin 3 on the left to pin 2 on the right. If there were opposing transmitters and receivers, all green LEDs on pins 2 and 3 should be lit.

When monitoring data transmission on either pin 2 or pin 3, data activity will be indicated by both the red and green LED's being on.

Control signal changes are typically at slower change rates, therefore either the red or green LED's will be lit. In most devices, hardware handshake control is accomplished with Request-To-Sent (pin 4), and Clear-To-Send (pin 5), Data Set Ready (pin 6), Data Carrier Detect (pin 8) and Data Ter-

minal Ready (pin 20). What makes RS-232 interfacing difficult at times is that one device may require all of the above control functions and the other device may require only one or none. It is in these instances that the breakout box becomes the essential tool needed to diagnose and determine the correct interface cable requirements.

TESTING PARALLEL DATA INTERFACES

The Model 1000 can be used as an effective tool to test and troubleshoot parallel interfaces that use DB25 connectors. The high impedance amplifiers that drive the LED indicators will readily interface with low power integrated circuits with no degradation in performance.

The primary consideration when using the Model 1000 in parallel test applications is to identify which connector pin is used for logic ground. Once this pin has been identified, OPEN the top four switches on the top switch deck and strap the signal ground post to the pin that has been identified as logic ground. CLOSE all line switches and connect the interface tester in-line between the two devices being tested.

Control signals such as "Acknowledge", "Busy" and "Strobe" will light the red LEDs if their signal levels are above +2.5 volts. Data lines will activate their respective LEDs as the data is passed through the interface tester.

CABLE TESTING

The Model 1000 Interface Tester can also be used as an effective cable tester. To test a cable for continuity, opens, and bridging, OPEN all breakout switches (switches down to the left). Connect the cable under test to each side of the Interface Tester. With a jumper strap, apply either the + or − test voltage to each pin post in sequence, 1 through 25. If there is "continuity" (a pin in one connector hooked to a pin in the other connector) through the cable, the appropriate LEDs will light on both sides of the tester. If a line is "open" (no connection), only one LED will light where the test voltage is applied. "Bridging" will be indicated by two or more LEDs lighting on the same side of the tester. This common occurrence indicates that various pins are jumpered or "bridged" in a connector.

To become familiar with the cable test feature of the Model 1000, OPEN all line switches and connect the two interface cables together behind the unit. Apply a test voltage to each pin, in sequence, on the left side of the breakout box and observe that the appropriate LED lights on the left side of the tester. Now do the same on the right side. To demonstrate bridging, CLOSE the "2-3" reversal switch and observe that both LEDs 2 & 3 will light (on both sides) when the test voltage is applied to either pin. To fully characterize an unknown cable, it is advisable to scan both ends of the cable. This procedure will detect bridging on one end that does not feed through to the other end.

TESTING INSTALLED CABLES USING THE OPTIONAL REMOTE MONITOR

An optional remote monitor/loopback module is available to allow you to test installed cables (when both ends of the cable cannot be brought together to be tested by the Model 1000 Interface Tester). The remote monitor is attached at one end of cable, and the Interface Tester (which acts as the driver) is attached at the other end. The signal ground return can be completed through the cable on pin 7, or an external ground may be used such as an electrical conduit pipe. Typically, pin 7 is used to complete the circuit. To accomplish this, connect the pin marked "GRD" to the pin labeled pin 7 on the remote monitor with the jumper strap supplied with the remote monitor.

After connecting the interface tester (either connector) and the remote monitor to the cable in question, turn the Power Switch to ON, and connect one end of a jumper strap to the +V test voltage pin. Make sure that all switches are in the open position. Using the jumper strap connected to +V, touch each of the test pins located on the same side of the tester that is connected to the cable. If there is continuity through the cable on the line being probed, that pin's red LED and pin 7's red LED will light. For example, if pin 2 is touched, both the red LEDs on pin 2 and pin 7 will light. If only pin 2 lights, there is no continuity through the cable (lead 2 is not being used). Bridges at the end of the cable being driven by the interface tester, will cause multiple LEDs to light.

If you have followed the above procedure, you've probably noticed that the LEDs on the remote monitor did not light. This is entirely accurate. The test described above will only verify which pins within the cable have continuity through the cable. This test will not indicate the pin to pin wiring configuration of the cable. Your Model 1000 is capable of providing this information. Please read on.

To determine the actual pin-to-pin wiring configuration, CLOSE the top two switches on the top switch deck. This connects the interface tester's LED ground lines to pin 7. Using the jumper strap connected to +V, apply the test voltage to those pins recorded as having continuity in the first test. Note that the pin 7 red LED will not light in this test. This is because it is now connected to logic ground. (do not apply the test voltage to pin 7). You will now notice that the remote monitor LEDs will light if there is continuity through the cable. With an operator at each end of the cable, the exact pin-to-pin wiring configuration can now be determined.

SELF TEST

It is very easy to quickly verify the operation of the Model 1000. First, OPEN the top 4 switches on the top switch deck. This disconnects Pin 7 from the battery and LED ground lines. Make sure that all 25 line switches are in the CLOSED position. Take a single jumper and attach it to either a + or – voltage post. With the other end of the jumper, touch

each of the 25 line posts on either side of the breakout switches. When a line post is contacted, the LEDs on both sides of the breakout switches will light. If + (plus) voltage is used, the red LEDs will light. If – (minus) voltage is used, the green LEDs will light. If desired, both plus and minus voltages can be used to test both red and green LEDs.

To observe how the 2 & 3 reversal switches work, OPEN the breakout switches for lines 2 & 3. Apply a test voltage, either + or – to pins 2 & 3 on the left side of the unit. Note that only the left hand LEDs will light. CLOSE the "2-3" and "3-2" reversal switches on the top switch deck. Apply a test voltage to pin 2 on the left. The appropriate polarity LED will light pin 2 on the left and pin 3 on the right. When contacting pin 3 on the left, pin 3 "left" and pin 2 "right" LEDs will light.

APPENDIX A
PREREQUISITES TO INTERFACE TESTING

Before attempting to test the RS-232C interface, perform a check on the following prerequisites for proper serial communication:

1. **Baud Rate** The data handling rate for both devices must be the same. Baud rates are typically set by switches or software. Consult your equipment manuals and set both devices to the same baud rate.

2. **Parity** Error checking formats must be identical between the two devices. Typically, five options are available on today's equipment. No parity. Odd Parity, Even Parity, Parity bit "on" and Parity bit "off". Using your equipment Manuals, make sure that both devices use the same parity error checking format.

3. **Word Size** (number of bits per character). As with error checking and baud rate, both devices must use the same number of bits per character. Some manufacturers include the parity bit when they state the number of bits per character, which may cause some confusion.

4. **Transmission Mode** Simplex, (one-way only), full duplex (bothways simultaneously) or half duplex (one direction at a time) transmission modes are used. Both devices should be set to the same mode. A transmission mode mismatch will be apparent when a terminal or printer displays double characters, or if a terminal can send data, but cannot display that data on the screen.

5. **Transmission Code** Typically this is not a problem because most manufacturers use the standard ASCII code. However, there may be some equipment that uses other codes for special applications. Consult your manual if you are in doubt.

6. **Transmission Timing** Historically, most small business machines have used asynchronous timing (derived from character start and stop bits), but synchronous interfaces are becoming more prevalent in todays micro computer

world. Again, both devices must use the same form of transmission timing. With asynchronous timing, the number of stop bits can sometimes be different between devices. Ensure that the same number of stop bits are selected at both ends. The options are generally 1, 1.5, or 2. Synchronous devices will probably require special cabling, depending on whether a modem is internally or externally clocked.

7. **Flow Control** Data flow must be regulated between devices such as a computer and printer. Improper setting of this option may cause data to be lost or garbled or not transmitted at all. Because of the difference in operating speeds, either the data must be buffered for delayed printing, or flow-control via hardware signals or software must occur. Both devices must be configured for the same flow-control method.

8. **Line Feeds** Typically, three choices are offered 0, 1 or 2. If a computer transmits a carriage return to a terminal printer, the device will perform line feeds according to this selection. A line feed setting of 0 may produce overwriting on the same line, as no vertical spacing takes place. If 1 is selected, single spacing will occur. A setting of 2 will create double spacing.

9. **Polarity** The importance of polarity is realized in the area of hardware flow-control. An option may exist for the BUSY signal to be either positive or negative when the buffer of a printer is full. If the transmitting device

requires a positive signal on the BUSY line to enable transmission, option the printer (or receiving device) to generate a positive signal when ready to receive data.

As the checklist indicates, there are many factors outside of the basic RS-232 requirements that are involved when interfacing serial data devices.

APPENDIX B
RS-232C SIGNAL DEFINITION

Contact No.	Pin Assignments RS-232C
1.	Protective Ground, Electrical Equipment Frame Ground. Also may be AC Power Ground.
2.	Transmitted Data. Data from terminal to data communications equipment (modem)
3.	Received Data. Data from modem to terminal.
4.	Request to Sent (RTS). Indicates to sending modem that terminal is ready to transmit.
5.	Clear to Send (CTS). Indicates to terminal that modem is ready to transmit.
6.	Data Set Ready (DSR). Indicates to terminal that modem is connected to a communications channel and not in a test or loopback mode.
7.	Signal Ground. The common ground reference potential for all circuits except protective ground.

8.	Received Line Signal Detector (RLSD). Indicates to terminal that receiving modem is receiving carrier from remote transmitting modem.
9.	Reserved for dataset testing. Often has positive (+12V) voltage available for testing.
10.	Reserved for dataset testing. Often has negative (−12V) voltage available for testing.
11.	Unassigned.
12.	Secondary Received Line Signal Detector. Indicates to terminal that receiving modem is receiving secondary from remote transmitting modem.
13.	Secondary Clear to Send. Indicates to terminal that local modem is ready to transmit data over secondary channel.
14.	Secondary Transmitted Data. Equivalent of transmitted data circuit on Pin 2 except that it is used to transmit signals over secondary channel.
15.	Transmitter Signal Element timing signal from modem to terminal transmitter interface to provide signal element timing.

16.	Secondary Received Data equivalent to received data circuit on Pin 3 except that it is used for receiving data from the secondary channel.
17.	Receiver Signal Element timing signal from modem to terminal receiver interface to provide signal element timing.
18.	Unassigned.
19.	Secondary Request to Send. Indicates to modem that sending terminal is ready to transmit data over the secondary channel.
20.	Data Terminal Ready (DTR). Signal from terminal to modem indicating that terminal is ready to receive and transmit data.
21.	Signal Quality Detector signal from modem indicating whether or not there is a predefined high probability of error in received data.
22.	Ring Indicator (R) signal from modem indicating that a ringing signal is being detected over the line.
23.	Data Signal Rate Selector. (DTE Source) Selects between the two data rates for dual rate modems.
24.	Transmit Signal Element Timing. Transmit clock supplied by terminal to modem.
25.	Unassigned.

APPENDIX C
AN EXAMPLE OF HOW TO USE THE MODEL 1000

Assume that you would like to interface a Xerox Model 1730 printer to a Hewlett-Packard HP125 computer. From their manuals you would obtain the following interface requirements:

HP-125 Computer

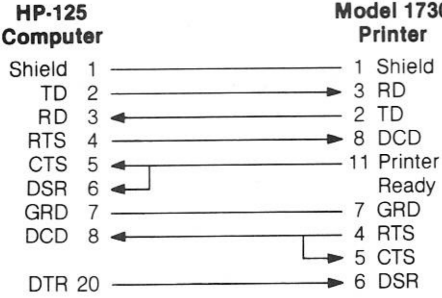
Pin	Function	Direction
1	Shield	N/A
2	Transmit Data	From HP-125
3	Receive Data	To HP-125
4	Request-To-Sent	From HP-125
5	Clear-To-Send	To HP-125
6	Data Set Ready	To HP-125
7	Signal Ground	N/A
8	Receive Ready (DCD)	To HP-125
20	Data Terminal Ready	From HP-125

Model 1730 Printer

Pin	Function	Direction
1	Shield	N/A
2	Transmit Data	From 1730
3	Receive Data	To 1730

4	Request-To-Sent	From 1730
5	Clear-To-Send	To 1730
6	Data Set Ready	To 1730
7	Signal Ground	N/A
8	Receive Line Signal Detector	To 1730
11	Printer Ready	From 1730
20	Data Terminal Ready	From 1730

If these two devices were connected together with a 25 wire, straight through, pin-to-pin cable, they would not work together. If we were to draw a pictorial diagram of the cable required for this interface it would be similar to the following:



We can use the Model 1000 Interface Tester and the 25 wire straight through cable to reconfigure and verify this

interface configuration. To reconfigure the Transmit and Receive Data lines, OPEN the pin 2 and pin 3 switches on the second switch deck from the top. CLOSE the "2-3" and "3-2" switches on the top switch deck. This will connect pin 2 on the computer to pin 3 on the printer and vice-versa.

To connect the computer's Request-To-Send control line to the printers' Receive Line Signal Detector (DCD), OPEN switches 4 and 8. With a jumper strap, connect the pin 4 terminal on the computer side of the tester to the pin 8 terminal on the printer side.

To connect Printer Ready (pin 11) to the computers Clear-To-Send (pin 5) and Data-Set-Ready (pin 6), OPEN switches 5 and 6. Using two jumper wires, connect pin 5 on the computer side to pin 11 on the computer side. Connect pin 6 on the computer side to pin 11 on the printer side of the tester. (This will result in pins 5 and 6 on the computer to be connected to pin 11 on the printer if switch 11 remains closed.)

To connect Receive Ready (DCD, pin 8) on the computer to Request-To-Send (pin 4) and Clear-To-Send (pin 5) on the printer, use the brown bridging jumper.

To connect the computer's Data-Terminal Ready line (pin 20) to the printer's Data-Set-Ready line (pin 6), OPEN switch 20 and jumper pin 20 on the computer side to pin 6 on the printer side.

When this reconfiguration is complete and the interface tester is connected in-line between the computer and printer, turn the power ON to both devices and initialize the devices

for operation. (Review the prerequisite check list to make sure that both devices are set to the same baud rate, parity, word size, flow control, etc.)

Before attempting data transmission, observe the LED's on each of the data and control lines. The TD and RD (pins 2 and 3) should be green on both the computer and printer sides.

When a program is run to send data to the printer, the computer's Request-To-Send (pin 4) and DTR (pin 20) LED's will turn red. The printer should respond with red LED's on pins 8, 11, and 6, and data transmission should be indicated by flickering red and green LED's at pin 2 on the computer side and pin 3 on the printer side. If hardwire flow control is used, pin 11 (Printer Ready) will turn green to stop data when the buffer is full. If X-ON/X-OFF characters are used for flow control, the printer will use RTS (pin 4) to control the flow of characters to the computer from Pin 2 (TD) to Pin 3 (RD) on the computer.

Once successful transmission and printing has been verified, the interface tester may be temporarily left in-line while a custom cable is being constructed. If left in the interface line, turn the on-off power switch to OFF to conserve the batteries in the tester.

From the above example, it is obvious that the interface tester is an essential tool when installing or servicing data communication lines. Also, familiarity with the control line functions of the RS-232C standard will enhance the operators ability to quickly install and maintain his system.